

DOT POINT

VISIT...

IB BIOLOGY OPTIONS



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What the book includes

This book provides questions and answers for each dot point in the IB Biology Options syllabus from the International Baccalaureate Diploma Programme for Biology:

- Human Nutrition and Health
- Physiology of Exercise
- Cells and Energy
- Evolution
- Neurobiology and Behaviour
- Microbes and Biotechnology
- Ecology and Conservation
- Further Human Physiology

Format of the book

The book has been formatted in the following way:

1.1 Subtopic from syllabus.

1.1.1 Assessment statement from syllabus.

1.1.1.1 First question for this assessment statement.

1.1.1.2 Second question for this assessment statement.

The number of lines provided for each answer gives an indication of how many marks the question might be worth in an examination. As a rough rule, every two lines of answer might be worth 1 mark.

How to use the book

Completing all questions will provide you with a summary of all the work you need to know from the syllabus. You may have done work in addition to this with your teacher as extension work. Obviously this is not covered, but you may need to know this additional work for your school exams.

When working through the questions, write the answers you have to look up in a different colour to those you know without having to research the work. This will provide you with a quick reference for work needing further revision.

Command Terms and Verbs to Watch

account, account for State reasons for, report on, give an account of, narrate a series of events or transactions.

analyse Interpret data to reach conclusions.

annotate Add brief notes to a diagram or graph.

apply Use an idea, equation, principle, theory or law in a new situation.

assess Make a judgement of value, quality, outcomes, results or size.

calculate Find a numerical answer showing the relevant stages in the working (unless instructed not to do so).

clarify Make clear or plain.

classify Arrange into classes, groups or categories.

comment Give a judgement based on a given statement or result of a calculation.

compare Give an account of similarities and differences between two (or more) items, referring to both (all) of them throughout.

construct Represent or develop in graphical form.

contrast Show how things are different or opposite.

deduce Reach a conclusion from the information given.

define Give the precise meaning of a word, phrase or physical quantity.

demonstrate Show by example.

derive Manipulate a mathematical relationship(s) to give a new equation or relationship.

describe Give a detailed account.

design Produce a plan, simulation or model.

determine Find the only possible answer.

discuss Give an account including, where possible, a range of arguments for and against the relative importance of various factors, or comparisons of alternative hypotheses.

distinguish Give differences between two or more different items.

draw Represent by means of pencil lines.

estimate Find an approximate value for an unknown quantity.

evaluate Assess the implications and limitations.

examine Inquire into.

explain Give a detailed account of causes, reasons or mechanisms.

extract Choose relevant and/or appropriate details.

extrapolate Infer from what is known.

identify Find an answer from a given number of possibilities.

justify Support an argument or conclusion.

label Add labels to a diagram.

list Give a sequence of names or other brief answers with no explanation.

measure Find a value for a quantity.

outline Give a brief account or summary.

predict Give an expected result.

propose Put forward a point of view, idea, argument, suggestion etc for consideration or action.

recall Present remembered ideas, facts or experiences.

show Give the steps in a calculation or derivation.

sketch Represent by means of a graph showing a line and labelled but unscaled axes but with important features (for example, intercept) clearly indicated.

solve Obtain an answer using algebraic and/or numerical methods.

state Give a specific name, value or other brief answer without explanation or calculation.

suggest Propose a hypothesis or other possible answer.

summarise Express concisely the relevant details.

synthesise Put together various elements to make a whole.

Human Nutrition and Health

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OPTION A

Human Nutrition and Health

A1 Components of the human diet. © IBO 2007

A.1.1 Define nutrient. © IBO 2007

A.1.1.1 What is a nutrient?

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A.1.2 List the type of nutrients that are essential in the human diet, including amino acids, fatty acids, minerals, vitamins and water. © IBO 2007

A.1.2.1 What is meant by as essential nutrient?

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A.1.2.2 Complete the table to identify essential nutrients according to their chemical grouping.

Food group	Examples of essential nutrients
Amino acids	
Fatty acids	
Minerals	
Vitamins	
Water	

A.1.3 State that non-essential amino acids can be synthesised in the body from other nutrients. © IBO 2007

A.1.3.1 Why are some amino acids called non-essential?

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A.1.4 Outline the consequences of protein deficiency malnutrition. © IBO 2007

A.1.4.1 Define malnutrition.

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A.1.4.2 Outline what happens if the diet has insufficient protein.

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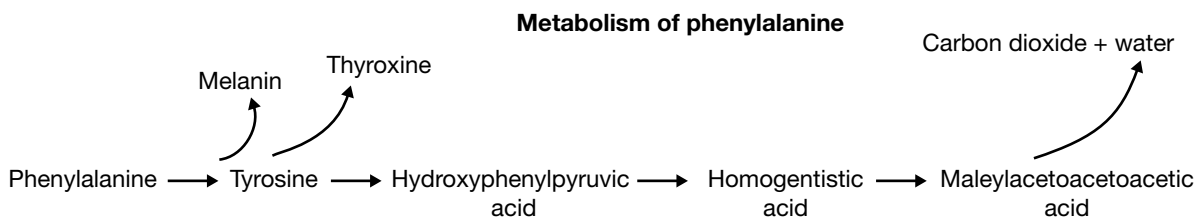
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A.1.5 Explain the causes and consequences of phenylketonuria (PKU) and how early diagnosis and a special diet can reduce the consequences. © IBO 2007

A.1.5.1 Annotate the flow chart of the metabolism of phenylalanine to show how the genetic disorder PKU leads to a disruption of the pathway.



A.1.5.2 Complete the table to summarise the disease phenylketonuria (PKU).

Phenylketonuria	
Feature	Description
Cause	
Symptoms	
Why symptoms occur	
Early diagnosis	
Treatment	

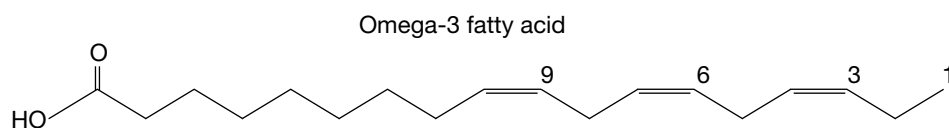
A.1.6.1 Complete the table to compare saturated fatty acids and unsaturated fatty acids.

Feature	Unsaturated fatty acids	Saturated fatty acids
Definition		
Diagram of a fat		
Configuration		
Example	Monounsaturated	Polyunsaturated

A.1.6.2 Distinguish between monounsaturated fatty acids and polyunsaturated fatty acids.

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A.1.6.3 The diagram shows the structure of an omega-3 fatty acid. Describe omega-3 fatty acids.



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A.1.7 Evaluate the health consequences of diets rich in the different types of fatty acid. © IBO 2007

A.1.7.1 Explain why people talk about ‘bad cholesterol’ and ‘good cholesterol’.

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A.1.7.2 Explain why it is advisable for health reasons to limit the amount of trans fatty acid consumed each day.

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A.1.7.3 Use examples to evaluate the impact of different dietary intake of fatty acids of different cultures on health issues.

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A.1.8 Distinguish between minerals and vitamins in terms of their chemical nature. © IBO 2007

A.1.8.1 What is a mineral?

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A.1.8.2 What is a vitamin?

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A.1.9 Outline two of the methods that have been used to determine recommended daily intake of vitamin C. © IBO 2007

A.1.9.1 Describe the recommended daily intake (RDI).

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A.1.9.2 Outline why another method to determine recommended daily intake of vitamin C is used.

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A.1.9.3 Outline a method involving human subjects that has investigated the relationship between vitamin C and disease.

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A.1.9.4 Outline an investigation involving small mammals that has looked at the relationship between vitamin C and disease.

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A.1.10 Discuss the amount of vitamin C that an adult should consume per day, including the level needed to prevent scurvy, claims that higher intakes give protection against upper respiratory tract infections, and the danger of rebound malnutrition. © IBO 2007

A.1.10.1 Identify the major sources of vitamin C in a diet.

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A.1.10.2 Discuss the issues in determining the amount of vitamin C that is needed to prevent scurvy.

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A.1.10.3 Discuss how the recommended amount of vitamin C that needs to be consumed daily can vary.

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A.1.10.4 Discuss how the amount of vitamin C that needs to be consumed daily to prevent chronic disease and promote health varies from the RDI.

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A.1.10.5 Discuss the problem of rebound malnutrition.

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A.1.11 List the sources of vitamin D in human diets. © IBO 2007

A.1.11.1 List some sources of vitamin D in human diets.

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A.1.12 Discuss how the risk of vitamin D deficiency from insufficient exposure to sunlight can be balanced against the risk of contracting malignant melanoma. © IBO 2007

A.1.12.1 Describe the major functions of vitamin D in the body.

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A.1.12.2 The diagram shows the legs of a child with vitamin D deficiency. Describe the symptoms of vitamin D deficiency.

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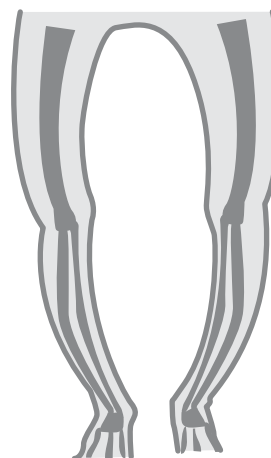
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Legs of a child with rickets



A.1.12.3 Describe the relationship between vitamin D, sunlight and the risk of malignant melanoma.

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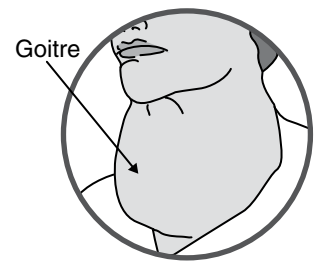
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A.1.13 Explain the benefits of artificial dietary supplementation as a means of preventing malnutrition, using iodine as an example. © IBO 2007

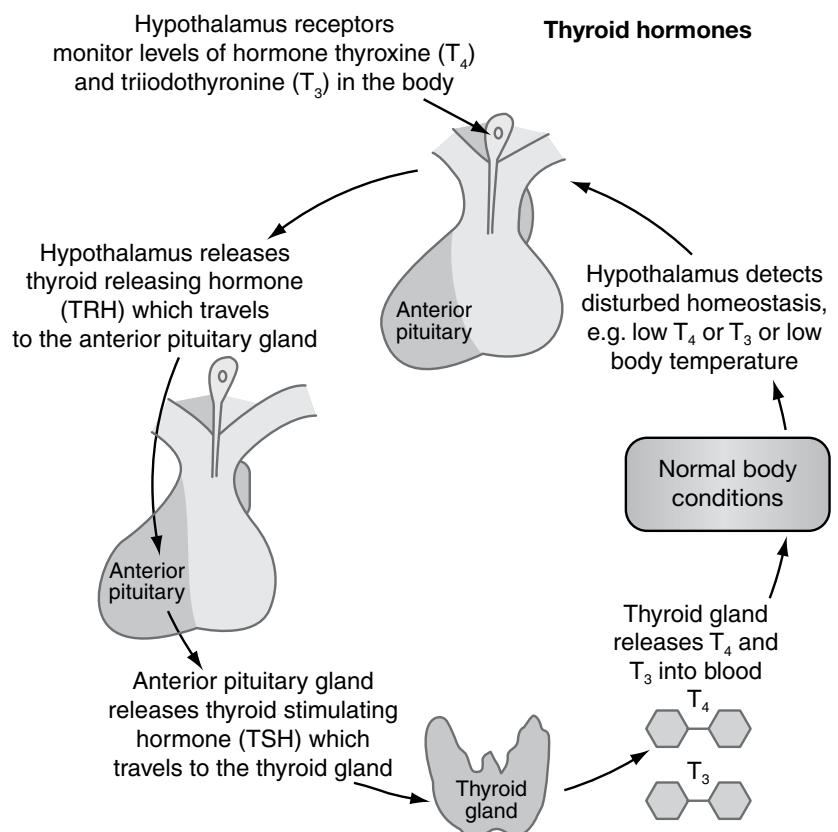
A.1.13.1 The diagram shows a person with a goitre. Discuss the relationship between iodine and the thyroid gland.



A.1.13.2 Explain what happens if a diet is deficient in iodine.

A.1.13.3 Explain why many countries have iodine added to salt (iodised salt).

A.1.13.4 The diagram shows the negative feedback system for the production of thyroid hormones. Annotate the diagram to show how an iodine deficiency leads to a goitre.





A.1.14 Outline the importance of fibre as a component of a balanced diet. © IBO 2007

A.1.14.1 In a diet, outline what is meant by fibre.

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A.1.14.2 Outline the need for insoluble fibre in a diet.

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A.1.14.3 Outline the need for soluble fibre in a diet.

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A.1.14.4 Discuss the use of fibre supplements in a diet.

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A.1.14.5 Suggest why the recommended dietary allowance (RDA) for fibre was not introduced until 2002.

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A.2.1 Compare the energy content per 100 g of carbohydrate, fat and protein. © IBO 2007**A.2.1.1** Complete the table to compare the energy content per 100 g of different food groups.

Food group	Energy (kJ/100 g)
Carbohydrate	
Fat	
Protein	

A.2.2 Compare the main dietary sources of energy in different ethnic groups. © IBO 2007**A.2.2.1** Complete the table to summarise the different dietary sources of energy used around the world.

Dietary source of energy	Groups around the world that use this dietary source as a staple energy source
Rice	
Wheat	
Cassava	
Maize	
Fish	
Meat	



A.2.3 Explain the possible health consequences of diets rich in carbohydrates, fats and proteins. © IBO 2007

A.2.3.1 Explain possible health consequences for a diet rich in carbohydrates.

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A.2.3.2 Explain possible health consequences for a diet rich in fatty acids.

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A.2.3.3 Explain possible health consequences for a diet rich in protein.

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A.2.4 Outline the function of the appetite control centre in the brain. © IBO 2007

A.2.4.1 Identify the location of the appetite control centre in the brain.

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A.2.4.2 Outline the function of the appetite control centre of the brain.

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A.2.4.3 Outline how the hormone leptin is involved in appetite control in mammals.

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A.2.4.4 Outline how the hormone ghrelin is involved in appetite control in mammals.

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A.2.5 Calculate body mass index (BMI) from the body mass and height of a person. © IBO 2007

A.2.5.1 Define body mass index (BMI).

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A.2.5.2 Write the equation to show how body mass index (BMI) is calculated.

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A.2.5.3 Identify some groups of people who should not use the BMI.

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A.2.6 Distinguish, using the body mass index, between being underweight, normal weight, overweight and obese. © IBO 2007

A.2.6.1 Complete the table to identify underweight, normal weight, overweight and obese using BMI.

Status	Body mass index (BMI)
Underweight	
Normal weight	
Overweight	
Obese	

A.2.6.2 Calculate the BMI for each individual and assess their status as underweight, normal weight, overweight or obese.

Name	Height (cm)	Weight (kg)	BMI	Status
Susan	165	62		
Ashleigh	172	78		
Thomas	177	55		
Ralph	155	74		
Chris	167	56		
Sam	169	50		



A.2.7 Outline the reasons for increasing rates of clinical obesity in some countries, including availability of cheap high-energy foods, large portion sizes, increasing use of vehicles for transport, and a change from active to sedentary occupations. © IBO 2007

A.2.7.1 Define obesity.

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A.2.7.2 Outline how obesity is defined in children.

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A.2.7.3 Complete the table to outline how each factor contributes to obesity in some countries.

Factor	How it contributes to obesity
Cheap high-energy foods	
Large portion sizes	
Vehicles for transport	
Sedentary occupation	

A.2.8 Outline the consequences of anorexia nervosa. © IBO 2007

A.2.8.1 Complete the table to summarise anorexia nervosa.

Anorexia nervosa	
Feature	Description
Definition	
Cause and characteristics	
Consequences and symptoms	
Treatment	
Control	

A.3.1 Distinguish between the composition of human milk and artificial milk used for bottle-feeding babies. © IBO 2007

A.3.1.1 Discuss why the composition of breast milk can vary.

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A.3.1.2 Discuss why the composition of artificial milk used for bottle-feeding babies can vary.

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A.3.1.3 Complete the table to compare the composition of human milk and artificial milk used for bottle-feeding.

Component	Human breast milk	Artificial milk for bottle-feeding
Protein		
Carbohydrates		
Fats		
Minerals and vitamins		
Enzymes		



A.3.2 Discuss the benefits of breastfeeding. © IBO 2007

A.3.2.1 Discuss why breastfeeding is beneficial for the child.

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A.3.2.2 Discuss why breastfeeding is beneficial for the mother.

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A.3.2.3 Discuss why it is important for the child to receive the colostrum.

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A.3.2.4 Discuss some issues which influence the choice of breastfeeding or using artificial milk for bottle-feeding a baby.

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A.3.3 Outline the causes and symptoms of type II diabetes. © IBO 2007

A.3.3.1 Complete the table to summarise the cause and symptoms of type II diabetes.

Type II diabetes mellitus	
Factor	Description
Definition	
Glucose levels and insulin levels in plasma	
Causes	
Symptoms	

A.3.4 Explain the dietary advice that should be given to a patient who has developed type II diabetes. © IBO 2007

A.3.4.1 Explain the dietary treatment for type II diabetes.

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A.3.5 Discuss the ethical issues concerning the eating of animal products, including honey, eggs, milk and meat. © IBO 2007

A.3.5.1 Complete the table to summarise different forms of issues that deal with the eating of animal products.

Issues dealing with the eating of animal products	
Reason	Examples
Ethical reasons	
Religious reasons	
Environmental reason	
Health reason	



A.3.6 Evaluate the benefits of reducing dietary cholesterol in lowering the risk of coronary heart disease. © IBO 2007

A.3.6.1 What is coronary heart disease?

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A.3.6.2 Discuss why high levels of cholesterol in blood serum is a problem.

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A.3.6.3 Describe the relationship between cholesterol in blood serum and dietary fatty acids.

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A.3.6.4 Describe the relationship between cholesterol in blood serum and dietary cholesterol.

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A.3.6.5 Outline how LDL receptors in a cell affect blood serum levels and cholesterol.

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A.3.7 Discuss the concept of food miles and the reasons for consumers choosing foods to minimise food miles. © IBO 2007

A.3.7.1 Define food mile.

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A.3.7.2 Complete the table to compare the advantages and disadvantages of increased food miles.

Benefit of increased food miles	Disadvantages of increased food miles



DOT POINT

ANSWERS



OPTION A Human Nutrition and Health

A.1.1.1 A nutrient is any chemical substance found in foods that can be used by the human body.

A.1.2.1 An essential nutrient is one that cannot be synthesised by the body and must be included in the dietary intake.

A.1.2.2

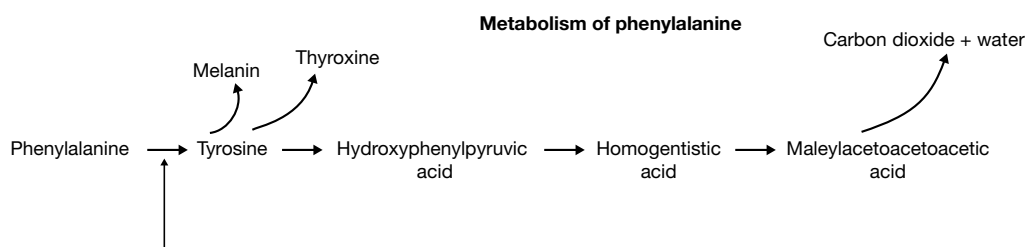
Food group	Examples of essential nutrients
Amino acids	There are 20 amino acids and eight are essential in the adult human diet – isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. Because the pathways that synthesise the other amino acids are not fully developed in children, there are additional essential amino acids needed by infants and children, e.g. histidine.
Fatty acids	The human body can make all fatty acids except for two – omega-6 fatty acid, e.g. linoleic acid (LA) and omega-3 fatty acids, e.g. alpha-linolenic acid (ALA).
Minerals	Inorganic minerals are needed in small amounts. Humans need large amounts of calcium and phosphorus to maintain bones, with calcium also needed for muscle and nerve functioning and phosphorus for ATP and nucleic acids. Iron is essential for haemoglobin and RBCs and in cellular respiration. Iodine is needed for producing thyroid hormones.
Vitamins	There are 13 essential vitamins – four fat-soluble and nine water-soluble. Although vitamins are required in smaller quantities compared to amino acids and fatty acids, a lack will lead to a deficiency disease. Vitamins include vitamin C (ascorbic acid), vitamin A (retinol), vitamin E (tocopherol).
Water	A sufficient intake of water is essential to maintain proper functioning and to replace water lost by urine and evaporation. Water is the main solvent in the body and all metabolic processes depend upon correct osmoregulation.

A.1.3.1 Non-essential amino acids can be synthesised by the body from other nutrients, e.g. alanine and asparagines.

A.1.4.1 Malnutrition is a general term that covers nutritional disorders due to both quantitative (e.g. too much food or not enough food) or qualitative (deficiency of vitamins or minerals or protein etc) problems with food intake.

A.1.4.2 A diet deficient in protein means there are insufficient amounts of needed amino acids to create the proteins for growth and development. If the victim is a child, development can be retarded causing physical and mental problems. In kwashiorkor disease the child has sufficient calories but insufficient protein. This disease leads to stunted growth, oedema with fluid retention in the tissues causing the distinguishable distended belly and the child becomes weak and inactive. Resistance to infection is usually reduced and can lead to death.

A.1.5.1

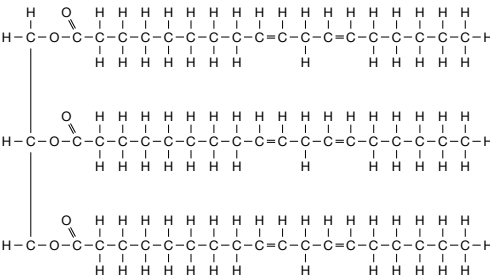
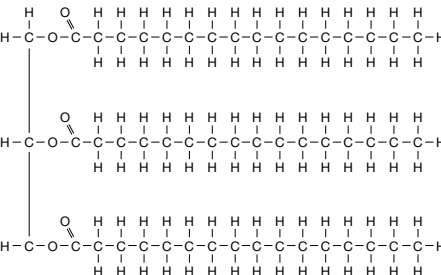
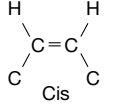
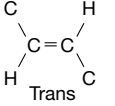


Normal enzyme is phenylalanine hydroxylase. A faulty enzyme in the disease PKU means phenylalanine cannot be converted to tyrosine and the pathway stops. The phenylalanine is converted to phenylpyruvic acid. Both phenylalanine and phenylpyruvic acid are toxic to the nervous system causing the symptoms of the disease, e.g. mental retardation and seizures.

A.1.5.2

Phenylketonuria	
Feature	Description
Cause	Phenylketonuria (PKU) is a genetic disease caused by a defective gene on chromosome 12 for the enzyme phenylalanine hydroxylase. It is autosomal recessive which means each parent must carry at least one defective allele and the child must inherit two defective alleles, one from each parent.
Symptoms	Mental retardation, seizures, hyperactivity, learning disabilities, a musty/mousy odour from skin, hair, sweat and urine, light skin colour and eczema.
Why symptoms occur	The enzyme phenylalanine hydroxylase normally converts the amino acid phenylalanine (an essential amino acid) into the amino acid tyrosine. If the reaction does not occur, phenylalanine is converted into phenylpyruvic acid. Both phenylalanine and phenylpyruvic acid are toxic to the nervous system. Accumulation of the toxins will cause problems with brain development and the other symptoms. The mousy smell is due to a build-up of phenylacetate.
Early diagnosis	Most developed countries carry out a routine newborn screening test for PKU, e.g. within the first day after birth.
Treatment	If treatment begins immediately, the newborn can grow up without damage to the nervous system. Affected children must have a special diet low in phenylalanine and high in tyrosine for at least the first 16 years of their life. This means a diet low in red meat, chicken, fish, nuts, cheese, legumes and dairy products.

A.1.6.1

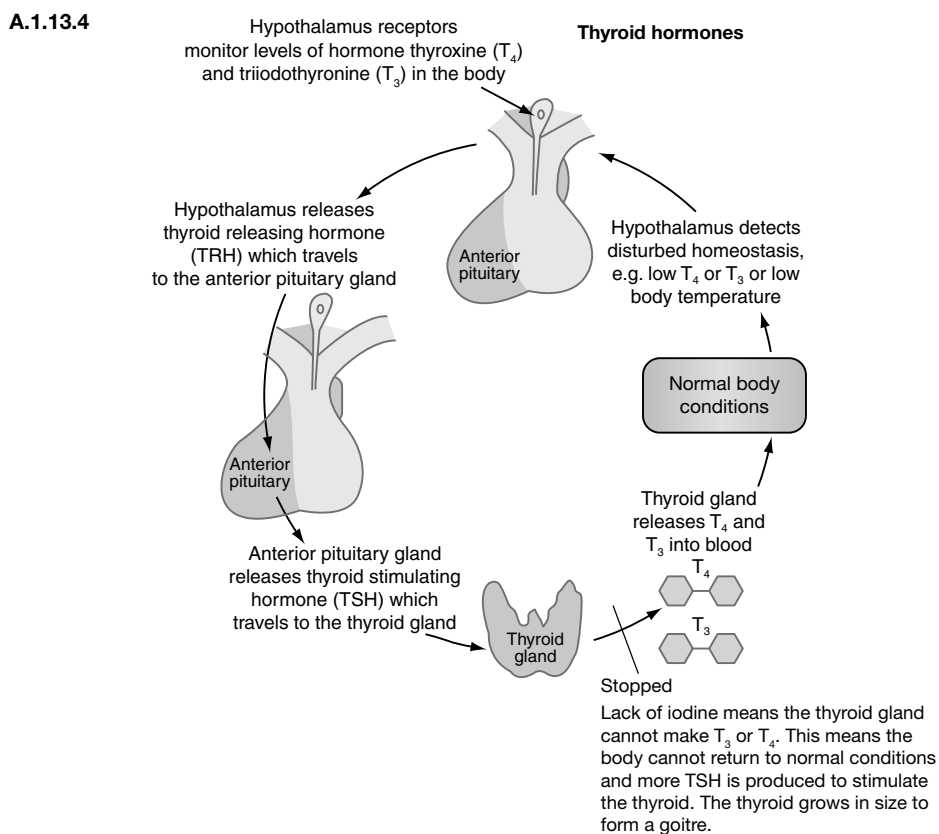
Feature	Unsaturated fatty acids		Saturated fatty acids
Definition	Has one or more double bonds formed by the removal of hydrogen atoms from the carbon skeleton.		Has no double bonds between carbon atoms composing the chain with as many hydrogen atoms as possible bonded to the carbon skeleton.
Diagram of a fat			
Configuration	 Adjacent hydrogens are on the same side of the double bond.	 The next two hydrogen atoms are on opposite sides of the double bond.	No double bond therefore cis and trans not possible.
Example	Monounsaturated: Lauroleic (12:1 <i>n</i> -3) has 12 carbons and one double bond on the third carbon from the methyl terminal. Palmitoleic (16:1 <i>n</i> -7).	Polyunsaturated: Linoleic (18:2 <i>n</i> -6). Alpha-linolenic (18:3 <i>n</i> -3).	Palmitic (16:0) has 16 carbon atoms and no double bonds. Valeric (5:0).

A.1.6.2 Monounsaturated fatty acids have only one double bond. Polyunsaturated fatty acids have more than one double bond, e.g. omega-3.

A.1.6.3 Omega-3 fatty acids (or ω -3 fatty acids) are a family of unsaturated fatty acids with the final carbon-carbon double bond in the *n*-3 position (counting from the side of CH₃ (not the end with carboxylic acid)). Omega-3 fatty acids include alpha-linolenic acid (ALA) and docosahexaenoic acid (DHA) which are polyunsaturated. The human body cannot synthesise *n*-3 fatty acids but can convert alpha-linolenic acid into other forms, which is why ALA is an essential fatty acid. There are heart-health benefits from long-chain omega-3 fatty acids.

- A.1.7.1** Cholesterol travels in the blood as a lipoprotein – many cholesterol molecules and other lipids bound to a protein. ‘Bad cholesterol’ is low-density lipoproteins (LDLs) and ‘good cholesterol’ is high-density lipoproteins (HDLs). LDLs are associated with plaque deposits and growths on the inner walls of arteries while HDLs seem to reduce the cholesterol deposited within blood vessels. Thus people talk about ‘bad cholesterol’ as it is associated with many diseases, e.g. atherosclerosis, hypertension and coronary heart disease and treatment involves changing their diet to reduce the intake of LDLs (e.g. animal fat and dairy products). Exercise increases HDL concentration while smoking decreases HDL and increases LDL levels.
- A.1.7.2** Trans fatty acids are unsaturated and have a trans double bond that gives the molecule a ‘kink’ compared to a cis molecule. Trans fatty acids are found in animal products, e.g. beef, pork, lamb and in dairy products, e.g. butter, milk. The trans bond is also produced in the hydrogenation of plant oils, e.g. making margarine, cooking oils. Trans fatty acids raise the levels of LDLs and lower HDLs similar to saturated fatty acids and there seems to be a relationship between trans fatty acids and many diseases, e.g. atherosclerosis, hypertension, coronary heart disease. Thus it is advisable to limit the amount of trans fatty acids consumed each day. Nutrition labels will have a listing of the amount of trans fat present in a product.
- A.1.7.3** Different cultures often place different emphasis on the foods used as a basis for their diet. These diets will then differ in the amounts of saturated fats, monounsaturated fats and polyunsaturated fats. The effect on health issues due to these diets can be inferred by the number of heart disease problems as there is a correlation between fat intake and heart disease. Cultures which use olive oil, which is high in monounsaturated fatty acids, e.g. Mediterranean countries, have a relatively low incidence of heart disease. The Japanese who base their diet on fish and rice with little fat and cholesterol also have a lower rate of heart disease. However, French cuisine involves meat, cream and butter and they also have a lower rate of heart disease. To evaluate these examples there seems to be only a small correlation between the dietary intake of fatty acids by different cultures and heart disease. Migration with a mixing of the gene pool, the proliferation of cooking shows and healthy lifestyle shows broadcast on TV has caused a mixing of different cultures and cooking preferences, the introduction of takeaway food and the greater accessibility of different foods means that many other issues need to be considered. Epidemiological data needs to be collected rather than looking at traditional cultures and the relationship between their intake of fatty acids and the incidence of health issues.
- A.1.8.1** A mineral is an element in ionic form, e.g. Ca^{2+} , K^+ , Zn^{2+} .
- A.1.8.2** Vitamins are organic compounds. Vitamins are either water-soluble, e.g. vitamins B₁, B₂, niacin, B₆, B₁₂, C, or fat-soluble, e.g. vitamins A, D, E and K.
- A.1.9.1** The recommended daily intake (RDI) is an estimation of the amount of a nutrient a healthy person needs to consume to meet their needs considering their age group and gender. The RDI is based on the prevention of a deficiency disease and was adopted in 1997 as a development of the RDA (recommended daily allowance). RDI is used for nutrition labelling.
- A.1.9.2** The RDI is based on preventing a deficiency disease. The results of several epidemiological studies suggest that increased levels of vitamin C prevent chronic disease and promote optimum health. This method of determining the daily intake of vitamin C dramatically increases the dosage.
- A.1.9.3** There have been several prospective cohort studies that have been carried out to investigate the relationship between vitamin C intake and diseases, e.g. coronary heart disease, lung cancer, stroke and gout. In these studies a group of people (cohort) were interviewed or tested for risk factors (e.g. nutrient uptake) then the cohort was followed over time to determine their healthiness. These studies have led to the suggestion that higher doses, e.g. 400 mg per day of vitamin C will help reduce the risk of these diseases.
- A.1.9.4** Guinea pigs, like humans cannot synthesise vitamin C. Some investigations with guinea pigs have shown that increased amounts of vitamin C leads to increased serum levels of antibodies and complement proteins. Other investigations have found no beneficial change in white blood cell count or functioning with high vitamin C treatment.
- A.1.10.1** Vitamin C is found in many plants, e.g. citrus fruits (oranges, limes) and many fruits or vegetables, e.g. blackcurrants, red peppers, kiwifruit, brussels sprouts, strawberries. If diets do not contain the fresh fruit or juices, vitamin C supplementary tablets can be taken.
- A.1.10.2** It has been suggested that scurvy can be prevented by as little as 10 mg per day of vitamin C. However, children or the elderly on a restricted diet are more susceptible and this amount has been raised to 40 mg per day for males and 30 mg per day for females. Since age, gender and activity can affect the need for vitamin C, the minimal amount needed to prevent scurvy will vary and different organisations and countries will list different amounts.
- A.1.10.3** The recommended intake of vitamin C per day will vary depending on gender, if you smoke and the year the dosage was prescribed, e.g. RDA in USA revised the amount for an adult (≥ 19 years old) in 2000 from 60 mg daily to 90 mg daily for a male and to 75 mg for a female. They also recommended that smokers take 35 mg above this amount as smoking increases the oxidative stress due to the toxins in cigarette smoke.
- A.1.10.4** Epidemiological studies into cardiovascular disease, coronary heart disease, stroke and lung cancer suggest that higher daily doses of vitamin C reduce the risk of these diseases. The current RDI for vitamin C is 90 mg for an adult male and 75 mg for an adult female. Doses of 400 mg or more have been suggested to prevent chronic disease and promote health.

- A.1.10.5** Rebound malnutrition occurs when the body is used to a certain level of nutrients (e.g. very high daily doses of vitamin C) and if the person stops taking this amount, the body may not quickly adjust to the change and problems of malnutrition arise. Since vitamin C is water-soluble, high intake levels mean a large amount is usually being excreted in the urine. If the body continues to excrete large amounts, and the intake is reduced rebound malnutrition can occur.
- A.1.11.1** Vitamin D is fat-soluble. Natural food sources include fish liver oils (e.g. cod liver oil), fatty fish species (e.g. herring, salmon, mackerel, sardines, tuna) and beef liver. Many products are fortified with vitamin D, e.g. milk, cereals, yoghurt, margarine, bread and pastries. There are supplementary vitamin D tablets that can be taken daily.
- A.1.12.1** Vitamin D promotes bone growth and is important in increasing the flow of calcium in the bloodstream by assisting the absorption of calcium and phosphorus from food into the intestines and the reabsorption of calcium in the kidneys. UV radiation in sunlight acts on sterols in the skin to produce vitamin D.
- A.1.12.2** Vitamin D deficiency leads to a softening of bones due to insufficient calcium and phosphorus being incorporated into the bones. In children, vitamin D deficiency causes rickets which slows growth and causes deformity of the long bones, e.g. typical bowed legs. In adults vitamin D deficiency leads to osteomalacia which is a bone-thinning disorder causing thin and brittle bones and osteoporosis which reduces bone mineral density and increases bone fragility.
- A.1.12.3** Vitamin D is made in the skin when UV light is absorbed by the epidermal layers. The amount of exposure to UV radiation needed to make vitamin D in the skin depends upon the season and distance from the equator. Higher amounts of melanin in the skin (darker skin colour) mean it takes longer for the skin to produce vitamin D. People who are concerned about getting a malignant melanoma (skin cancer) and stay out of the sun, may find they have a vitamin D deficiency. Similarly, people who live in high latitudes who have either dark skin or who stay indoors and wear large amounts of clothing when outside, often do not get enough exposure to sunlight and show symptoms of vitamin D deficiency.
- A.1.13.1** Iodine is a mineral used by the thyroid gland to synthesise the hormones triiodothyronine (T_3 – has three iodine atoms) and thyroxine (T_4 – has four iodine atoms).
- A.1.13.2** If a diet is deficient in iodine the levels of T_3 and T_4 in the bloodstream drop and they do not cause negative feedback on the hypothalamus and the pituitary gland. The pituitary continues to secrete thyroid stimulating hormone (TSH) in an attempt to stimulate the thyroid to make more T_3/T_4 . The thyroid cannot and thus the thyroid enlarges to form a goitre. Iodine deficiency can also lead to mental retardation and impaired physical growth in cretinism.
- A.1.13.3** Iodine deficiency can lead to the formation of a goitre or cretinism. Iodine is found in sea fish and thus there are many countries where local foods do not supply sufficient iodine to prevent some deficiency symptoms, e.g. inland areas where few seafoods are available. The introduction of iodised salt has reduced this problem showing that artificial dietary supplementation can prevent malnutrition and reduce the incidence of a deficiency disease within a population.



- A.1.14.1** Dietary fibre (or roughage) refers to indigestible material, e.g. unprocessed foods that contain a large amount of cells walls. There are two types of fibre – soluble fibre, e.g. pectin and insoluble fibre, e.g. cellulose.
- A.1.14.2** A balanced diet requires insoluble fibre, e.g. whole grains, wheat, nuts and seeds Insoluble fibre prevents constipation, helping food to move along the digestive tract. Insoluble fibre is inert and causes bulking and assists in preventing intestinal disorders and diseases including cancer. As the food moves through the large intestine water is absorbed and sufficient fibre is needed to maintain the flow. Dietary fibre also fills the stomach and gives a sense of being 'full' without a particularly high intake of calories compared to other foods, e.g. fats and thus many weight-reducing diets involve high fibre content.
- A.1.14.3** A balanced diet requires soluble fibre, e.g. legumes (peas and soybean), oats, oat bran, brown rice, and vegetables such as apples, oranges and carrots. Soluble proteins are readily fermented in the colon by bacteria that live in the gut and as the bacteria digest or absorb the materials they release by-products of their own metabolism. This includes some nutrients that can be used by the host, e.g. vitamins and also produces gases. The fermentation process also improves the absorption of minerals, especially calcium. Soluble fibre slows the absorption of glucose, which may help control blood sugar levels in people with diabetes. Soluble fibre absorbs water to make the stools softer, more viscous and easier to pass. This can reduce the transit time in the colon. Soluble fibres bind to bile acids which make it more difficult for absorption and this lowers blood cholesterol.
- A.1.14.4** Fibre supplements are taken to assist several conditions, e.g. to lower cholesterol, reduce the risk of colon cancer and to lose weight. Soluble fibre supplements are taken to assist with either diarrhoea or constipation and to treat irritable bowel syndrome.
- A.1.14.5** The RDA for fibre was probably not introduced until 2002 as it is not considered a nutrient like vitamins and minerals as it cannot be digested. However, since fibre is needed for maintaining good health it now has recommended values, e.g. 28 g per day.

A.2.1.1

Food group	Energy (kJ/100 g)
Carbohydrate	1760
Fat	4000
Protein	1720

A.2.2.1

Dietary source of energy	Groups around the world that use this dietary source as a staple energy source
Rice	A staple food for many countries. China, India, Indonesia, Bangladesh, Brazil and Vietnam are the highest consumers of rice.
Wheat	A staple food in the Mediterranean diet, used in the flour to make pasta, spaghetti and all countries which use wheat bread as a staple food.
Cassava	A starchy tubous root that is a staple food for tropical and subtropical countries. Most is produced in Africa, Asia, Latin America and the Caribbean.
Maize	(Known in some places as corn) is most widely grown in the Americas with USA producing nearly half the world's supply. It is also common in China, Brazil, Mexico, Argentina, India and France.
Fish	Coastal settlements rely more heavily on fish as an energy source than inland areas. Japan includes fish as a staple.
Meat	In Western diets about one-third of the energy comes from animal products. Many countries have low meat diets while Eskimos can have an all meat diet.

- A.2.3.1** A diet rich in carbohydrates provides energy and many people may consume a lot of carbohydrates, e.g. pasta before entering endurance competitions. If the diet is high in processed carbohydrates, e.g. white flour and white sugar, there may be insufficient vitamins, minerals and amino acids being consumed which can lead to malnutrition and other problems even though the total amount of calories may be high. High carbohydrate intake in the form of sugar can raise blood glucose concentration which can lead to diabetes, atherosclerosis and microvascular disease, problems with the kidneys, nerves and eyes. High carbohydrate intake in the form of dietary fibre is often used as a weight loss measure. The glycaemic index can be used to rate carbohydrate foods on how fast they are digested and enter the bloodstream as glucose.
- A.2.3.2** The effect of a diet rich in fatty acids depends on which fatty acids are being consumed and the effect on serum cholesterol – the LDL/HDL levels. A diet rich in animal lipids can raise cholesterol levels and lead to cardiovascular diseases. Plant lipids can enrich a diet if there is a large consumption of seeds or nuts or seed oils. Plant sterols inhibit cholesterol absorption. If the diet is too rich in lipids, triglycerides, which are the main energy storage form of lipids are deposited as body fat in subcutaneous and intravisceral areas causing weight gain.

A.2.3.3 A diet rich in protein can be based on animal protein, plant protein or cereal protein and the amount of protein required for growth, development and maintenance varies with age, gender and activities. Thus there are stages when more protein is required and the term enriched has to be flexible to cover these conditions. Not all proteins in a diet meet the need for nitrogen and indispensable amino acids. For example, animal foods and legumes are high in lysine while cereals and fruits are low in lysine. Very high protein diets can put stress on the kidneys which need to remove the excess nitrogen.

A.2.4.1 The appetite control centre in the brain is in the hypothalamus.

A.2.4.2 The appetite control centre of the brain responds to the hormones produced by the pancreas and small intestine after eating and by adipose tissue in response to fat storage and is responsible for either stimulating or repressing appetite.

A.2.4.3 Leptin is produced by adipose tissue. As these fat deposits increase leptin levels rise and negative feedback causes the brain to suppress appetite. If leptin levels drop, e.g. due to loss of body fat, appetite is stimulated.

A.2.4.4 Ghrelin is secreted in the lining of the stomach. Low levels of glycogen or glucose stimulate the secretion of ghrelin which acts on the hypothalamus to increase appetite for sweet and starchy foods. Ghrelin is often called the hunger hormone.

A.2.5.1 The body mass index (BMI) or Quetelet index is a weight/height index that correlates how much fat is on your body.

A.2.5.2 Body mass index = $\frac{\text{body mass (kg)}}{(\text{height (m)})^2}$

A.2.5.3 The BMI should not be used by anyone under 18, by pregnant or nursing women, frail and sedentary elderly people, competitive athletes and body builders.

A.2.6.1

Status	Body mass index (BMI)
Underweight	Below 18.5
Normal weight	18.5 to 24.9
Overweight	25.0 to 29.9
Obese	30.0 and above

A.2.6.2

Name	Height (cm)	Weight (kg)	BMI	Status
Susan	165	62	$\frac{62}{(1.65)^2} = 22.8$	Normal weight
Ashleigh	172	78	$\frac{78}{(1.72)^2} = 26.4$	Overweight
Thomas	177	55	$\frac{55}{(1.77)^2} = 17.6$	Underweight
Ralph	155	74	$\frac{74}{(1.55)^2} = 30.8$	Obese
Chris	167	56	$\frac{56}{(1.67)^2} = 20.1$	Normal weight
Sam	169	50	$\frac{50}{(1.69)^2} = 17.5$	Underweight

A.2.7.1 Obesity in adults can be defined using the BMI, e.g. BMI ≥ 30.0 is obese (this can be further subdivided into class I obesity 30.0 – 34.9, class II obesity 35.0 – 39.9, class III obesity > 40.0). Traditionally obesity was defined as an excess of body fat and body fat distribution pattern.

A.2.7.2 Obesity in children is difficult to define as height varies with age during growth. Obesity is often not defined as an absolute number but by looking at historical data and using a BMI greater than the 95th percentile.

A.2.7.3

Factor	How it contributes to obesity
Cheap high-energy foods	Many fast foods, e.g. hamburgers, chips, pizza and packaged 'snack' foods have high levels of sugars and/or fats. They can be cheap, easily available but often do not give the 'full' sensation which means people relying on these foods often increase their daily calorie intake and eat additional food.
Large portion sizes	To garner business many restaurants and fast food outlets serve larger portions or allow an 'upgrade' to increase their market share. This fosters increased intake of food and can increase daily intake of calories beyond what is needed considering age, gender and activity.
Vehicles for transport	The growth of cities has meant many people need to travel long distances which is not feasible by walking or cycling. Increased fear of crime has reduced the number of children playing in parks and in local streets and children are more likely to travel in vehicles to destinations.
Sedentary occupation	More jobs rely on technology, e.g. computers and labour-saving devices, e.g. machinery which reduces the need for physical activity and often forces people to sit at desks or at the control of mechanical equipment. Email has reduced the need to physically deliver messages to other workers. Housework has been assisted with the invention of many machines which reduce physical activity, e.g. washing machines, vacuum cleaners, central heating. Buildings have elevators and escalators to reduce the need to walk up stairs.

A.2.8.1

Anorexia nervosa	
Feature	Description
Definition	Is an eating disorder that is a form of self-starving when a person diets to the point of weighing 85% of normal healthy weight.
Cause and characteristics	Is caused by nervous and/or psychological factors and is characterised by extremely low body weight that is self-induced with a distorted body image and fear of gaining weight. Weight is controlled by starvation, excessive exercise and other weight-reducing measures, e.g. diet pills, laxatives and/or diuretic drugs. Most common in adolescent females in developed countries.
Consequences and symptoms	Physical effects include: extreme weight loss, stunted growth, fatigue, exhaustion, endocrine disorders, e.g. loss of menstrual periods for females, anaemia, easy bruising, swelling of the legs, overgrowth of down (fine hair) on face and arms, loss of head hair, constantly feeling cold, constipation, reduction in white blood cell count, chemical disturbance of homeostasis in blood due to repeated vomiting, abuse of laxatives and diuretics affects the heart, pallid complexion and sunken eyes, tooth decay usually due to repeated exposure to HCl from stomach on teeth, dry skin, dry or chapped lips, brittle fingernails, bed sores and wounds that take longer to heal, vertigo, fainting, headaches. Psychological effects include: obsession about body weight and body shape with a distorted image of their appearance, fear of food and of eating food, perfectionism, believe they need to use purgatives, diuretics to remove fluids and appetite suppressant tablets, obsessive compulsive disorder (OCD), believe that control over food/body means they have control of their life, food habits include gorging, binge eating followed by vomiting, refusal to accept body weight is too low and could be deadly and whole life centring on food affects relationships with relatives and friends.
Treatment	First treatment needs to increase body weight. It is often difficult to diagnose and treat as many sufferers hide their systems. Psychotherapy is needed and education about diet and exercise helps. Supervision in a hospital may be required.
Control	Removal of environmental and social factors to be thin. Education programs to increase public awareness about symptoms, risks and warning signs.

A.3.1.1

The composition of breast milk is fairly consistent, however it can vary slightly from day to day depending on the mother's diet. The ratio of water to fat can vary and the presence of antibodies will vary with individuals depending on the mother's immune system.

A.3.1.2

There are many formulas for artificial milk for bottle feeding babies, e.g. formulas can be divided into stage 1 (birth to 5 months), stage 2 (> 6 months). Many of these usually use skim cow's milk. There are special formulas if the baby has reflux – has specially treated corn starch which thickens when it reaches the baby's stomach, for constipation – where whey predominates, colic formulas – easier to digest with reduced lactose formulation, hypoallergenic formulas with proteins broken down into smaller segments and partially hydrolysed and less likely to be allergens, low lactose formulas where milk lactose is converted into readily absorbable glucose and galactose and 'sweet dreams' formulas with slowly absorbed carbohydrates to make the baby feel fuller. There are also hypoallergenic formulas for toddlers (> 1 year old) with free amino acids suitable for dietary management of protein maldigestion, fat malabsorption, severe food allergies and gastrointestinal tract impairment.

A.3.1.3

Component	Human breast milk	Artificial milk for bottle feeding
Protein	Contains casein, a-lactalbumin, IgA, IgG, lysozyme, serum albumin and β -lactoglobulin.	Cow's milk contains higher levels of protein and in forms which are harder to digest which put a strain on the baby's kidneys. Some children are also allergic to one or more of the protein components in cow's milk which is why there are hypoallergenic formulas containing free amino acids. The antibodies are not present which reduces immunity.
Carbohydrates	Mainly lactose and several lactose-oligosaccharides.	Human milk is thinner and sweeter than cow's milk.
Fats	Contains triglycerides and polyunsaturated fatty acids.	Cow's milk does not contain some essential fatty acids and most formulas have linoleic acid and α -linolenic acid added.
Minerals and vitamins	Contains calcium, phosphorus, sodium, potassium and vitamins.	Cow's milk does not contain sufficient vitamin E, iron and has excessive amounts of sodium and potassium. Formulas add minerals and vitamins and control the electrolytes (Na/K).
Enzyme	Contains lipase.	Usually no lipase.

A.3.2.1 There are many benefits of breastfeeding for the child. Breast milk contains antibodies and lymphocytes from the mother which means the infant is less likely to suffer from infections, e.g. cold and flu infections and middle ear infections. If the mother comes in contact with pathogens colonising the baby, she will make antibodies against those antigens which are delivered to the baby via breast milk. Proteins in breast milk are easily digested by the baby and the calcium and iron in breast milk are better absorbed. There is some suggestion there is less likelihood of sudden infant death syndrome (SIDS) with breastfeeding.

A.3.2.2 For the mother breastfeeding uses energy and assists in weight loss, depending on dietary intake. Breastfeeding also helps the uterus contract which assists returning the uterine wall to pre-pregnancy dimensions and shortens the bleeding time after delivery. Breastfeeding helps strengthen the bond between child and mother. Breastfeeding reduces the likelihood of breast cancer and it is cheaper. There is less likelihood of ovulation while breastfeeding, though this is not guaranteed as a method for contraception.

A.3.2.3 The colostrum is the initial milk produced by the breast. It is highly beneficial to the baby if it can receive this initial milk. Colostrum is very high in immunoglobulins, e.g. IgA which coats the intestinal tract. This provides immunological protection of the baby until its own immune system is functioning properly and causes a milk laxative effect assisting the meconium to leave the bowels of the baby and helping to prevent build-up of bilirubin which can lead to jaundice.

A.3.2.4 There are many cultural, social and economic reasons which determine if a woman breastfeeds or bottle-feeds her child. Sometimes the mother cannot feed the baby due to specific problems, e.g. she cannot produce enough milk, the baby cannot attach easily to the nipple, she requires specific medication, she has a specific illness or dehydration, the milk supply cannot flow easily to meet the demand or there are environmental pollutants in the milk which could harm the child, e.g. mother is exposed to organic mercury, lead or pesticides and it is contaminating the milk. Social attitudes also have a large impact on the decision to breastfeed or not. Different cultures and groups within cultures have different attitudes to breastfeeding. If the woman needs to return to work, the decision may be based on practical issues. The World Health Organisation recommends breastfeeding for at least the first six months, but decisions will always be based on individual needs of the mother and child.

A.3.3.1

Type II diabetes mellitus	
Factor	Description
Definition	Diabetes mellitus is a disease where there are abnormally high levels of plasma glucose concentrations. Type II diabetes is often called insulin resistance diabetes.
Glucose levels and insulin levels in plasma	Diabetes is characterised by high glucose levels in the plasma. In type II diabetes, there are usually normal levels of insulin in the plasma or even raised levels of insulin, until late in the disease; unlike type I diabetes where there are low levels of insulin in the plasma.
Causes	Genetic susceptibility is a contributing factor and family histories show inheritance patterns for type II diabetes. The majority of people with type II diabetes are obese and the disease is linked to weight gain after the age of 18, though some children are now getting type II diabetes. A sedentary lifestyle with the other factors increases the risk of getting the disease. There is also evidence linking excess weight around the middle of the body.
Symptoms	High glucose levels in the plasma identify the disease. Other symptoms include frequent urination, increased thirst with high fluid intake, increased appetite, blurred vision and hyperventilation. There is often normal functioning of the beta cells that produce insulin, until later stages. The body often blocks insulin carrying out its job which means the insulin receptors in cell membranes have been affected. Because overall metabolism is not functioning correctly there is usually a range of other associated problems, e.g. atherosclerosis, problems with eyes, kidneys and neurological changes.

A.3.4.1

Dietary advice for type II diabetes is to reduce body weight. Weight loss improves blood glucose levels and can also improve insulin sensitivity which means cells respond more quickly and effectively to high blood glucose and medication may not be needed. Exercise is also recommended to assist weight loss, especially to reduce the weight around the middle. Advisory diets usually recommend high fibre, fruit and complex carbohydrates. The complex carbohydrates are digested slowly and the fibre also slows down digestion and absorption. Fruit contains fructose which does not usually help increase glucose levels. Some drugs can be prescribed if high glucose levels persist.

A.3.5.1

Issues dealing with the eating of animal products	
Reason	Examples
Ethical reason	The need to increase food supplies to meet the demands of the growing human population has led to the introduction of new agricultural techniques, e.g. battery chicken farming, fish farming. Many people believe that keeping animals in these conditions is unethical and the animals should be free-range. Vegans will not eat or use any animal product due to concerns and moral convictions about animal rights, the effect on the environment of keeping herds of animals and for spiritual and religious reasons. They will not eat meat, poultry, seafood, eggs, or honey. They will not use products such as gelatin, whey, beeswax, leather or shellac. There are ethical concerns about the transportation of animals and this is a reason why some abjure meat. Transportation methods can lead to stress among the animals if they are overcrowded and not given sufficient water and nutrients during the journey. Some people have raised ethical concerns about procedures at abattoirs and the amount of stress and pain the animal endures before death. With new methods of producing transgenic species, there are many who will not eat genetically modified food (GM food) either from ethical reasons or for health reasons, e.g. drinking milk from genetically modified cows that produce a higher milk yield.
Religious reason	Several religions have rules about the eating of animal products and how the animal is to be killed. There are also rules about what is considered to be an animal, e.g. birds of the air and fish of the sea are considered separately to land-bound mammals. Jewish dietary law allows the eating of an animal that 'is cloven footed and cheweth the cud' which means they cannot eat the camel or hare (not cloven footed) or swine (does not chew cud), nor can they eat dolphin, porpoise and orca because they are not 'fish with fins and scales' (Leviticus 11). Sometimes there are seasonal prohibitions, e.g. no meat in Lent, which does not include fish. Hindus respect all life and are vegetarian. They do not eat beef, though some in coastal areas will eat fish. Buddhists have a list of meat that is unallowable, e.g. elephant, horses, dogs, snakes, lions and tigers. If meat or fish is allowable it must be cooked and cannot be eaten raw.
Environmental reason	Some people are concerned about the arable land that is needed for animal husbandry and the production of meat products. The animals need feeding and this requires more energy in the biomass energy pyramid. They believe it is more environmentally sound for people to eat producers in the food chain rather than higher trophic levels.
Health reason	Some people believe a vegetarian diet with high fibre and high carbohydrate is more healthy than being an omnivore.

A.3.6.1

Coronary heart disease is the failure of the coronary circulation to supply oxygen and nutrients to cardiac muscle and the surrounding tissues. It is often associated with atherosclerotic coronary heart disease when the vessels are blocked with plaque.

A.3.6.2

High levels of cholesterol in blood serum are a risk factor for coronary heart disease, e.g. if your cholesterol level is 6.5 mmol/L or greater, the risk of heart is around four times greater than a person with a cholesterol level of 4 mmol/L. Heart disease has several contributing factors beside high cholesterol in blood serum, e.g. smoking, high blood pressure and obesity and it takes several decades to develop.

A.3.6.3

For some people reducing their dietary intake of saturated fatty acids and trans fatty acids reduces blood cholesterol as some people are unusually sensitive to saturated fats and their blood cholesterol rises quickly when they eat it, while other people show less correlation between dietary intake and blood serum levels. Some saturated fats raise blood cholesterol more than others, e.g. butter, coconut oil and palm oil seem to have the greatest impact on blood cholesterol levels.

A.3.6.4

Dietary cholesterol is found exclusively in animal products, e.g. egg yolks, organ meats and butter. Studies to show the relationship between dietary cholesterol and blood cholesterol have provided conflicting information and seem to show that different individuals have different responses and at different times, the same individual can have different responses. On average, dietary cholesterol raises blood cholesterol, especially low-density lipoproteins (LDL). High levels of LDL is a contributing factor to atherosclerosis.

A.3.6.5

All cells, especially liver cells can monitor intercellular and intravascular levels of cholesterol. Liver cells produce cholesterol using energy and will import LDL in preference to save energy. An LDL receptor regulates the intracellular level of free cholesterol. Thus, if a cell needs cholesterol it will import LDL from the blood and serum cholesterol falls, while a cell overloaded with cholesterol will cause the receptor activity to drop and serum LDL levels increase. If there is no LDL, the cell will make its own.



A.3.7.1 A food mile is the distance between the site of production of a food and where it is consumed.

A.3.7.2

Benefit of increased food miles	Disadvantages of increased food miles
The ability to transport food anywhere in the world means the quantity and quality of food available has dramatically changed in recent decades. Fresh fruit and vegetables are available in areas where it is not their 'natural' season. Increased food miles means there is less chance of vitamin and mineral malnutrition due to lack of required available food types. In some instances it is more environmentally friendly with respect to energy consumption and release of greenhouse gases to increase the food miles and transport food to another country, rather than set up elaborate greenhouses to grow certain foods in certain countries. Increased food miles means there is continuity of supply and increased choice for consumers.	Reducing food miles has many benefits for both the consumer and the environment. Food that needs to be transported over long distances requires preservatives and treatment to make sure it does not spoil during transit. The additives and treatment methods can have an impact on the consumer, e.g. allergic reaction to preservatives. The environment can be affected in many ways, e.g. higher air pollution with longer food miles due to the energy consumption needed to move the food, increased traffic congestion and higher greenhouse gas emissions. Issues arise with the transport of live animals over long distances. Travel can cause stress in many animals and animal welfare needs to be considered.